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RELATIONS OF PAIN TO WEATHER,

STUDIED DURING ELEVEN YEARS OF

A CASE OF TRAUMATIC NEURALGIA.

BY

CAPTAIN R. CATLIN, U. S. ARMY.

WITH NOTES BY

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READ BEFORE THE COLLEGE OF PHYSICIANS OF PHILADELPHIA,
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THE

RELATIONS OF PAIN TO WEATHER,

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In *The American Journal of the Medical Sciences*, April, 1877, I described the case of Captain Catlin, U. S. Army, and gave the results of his observations on the relation of states of the weather to his own pain. These studies suggested by me, and carried out with care, at length became of equal interest to the observer—and, with occasional advice, he has continued to keep notes, until the record, with his comments, constitutes in my opinion a most valuable contribution to the strict science of medicine.

For full details of his case I must refer to my essay, but it is needful here to make a brief statement explanatory so that what he now says may be comprehensible without reference to the former record.

In August, 1864, Captain Catlin, then in perfect health, had his foot crushed in battle by a round shot. There was no shock; the leg was amputated below

the knee, and he was up and about in a month. Pai was felt early in the lost foot, and became sever within nine months.

I should perhaps state that except as concerns pai the observer is in admirable health, that his attack are so definite as to coming and going, as to creat little difficulty in this direction, and that from hi former position as instructor in certain scientific branches at West Point, he is well qualified by train- ing to pursue this difficult study. The weather re- ports of the signal office and his own, or the daily observations of others, have enabled him, from time to time, to relate these to his record of neuralgia, and by this method he has avoided the constant presence of daily thought as to what was about to happen in consequence of atmospheric changes. I may add that I never knew any man more free from unwhole- some attention to his own ailments. Most of what I learned from our former study, still stands unaltered by this much longer record; but there have been some fresh and suggestive gains in the relation of pain to meals, to daily barometric changes, and to magnetic conditions. The diagrams are readily un- derstood in connection with explanations given in the text, except those for the months of November and December, 1877, which we have given as an illustra- tion of the method of study, and of the obvious rela- tion of storms to pain.

The following is the report of the case for the past seven years, made by Captain Catlin :—

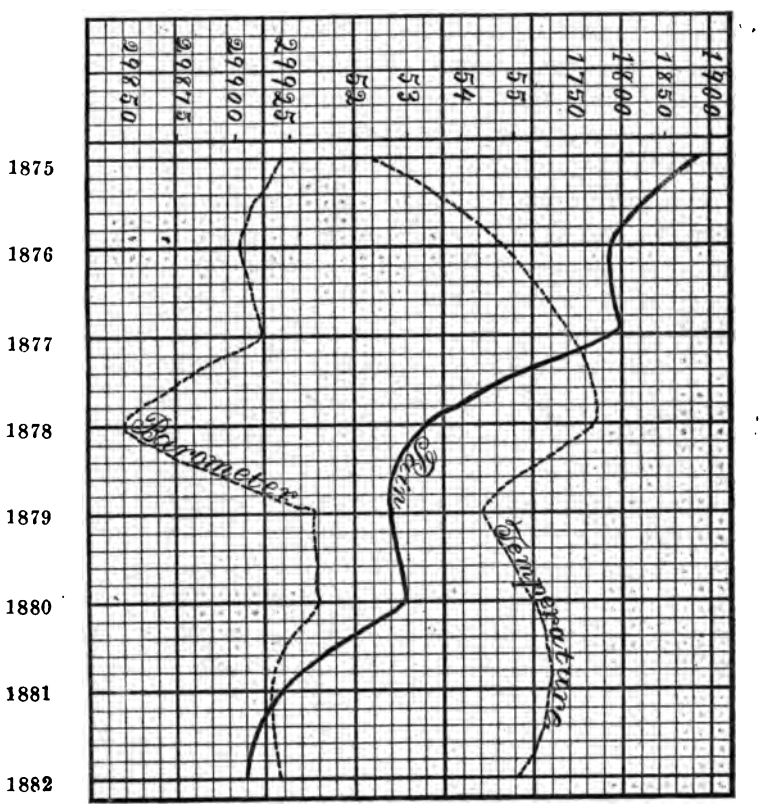
For the year 1872 there were 1783 hours of pain (the records for '73 and '74 are incomplete); for 1875 there were

1892 hours; for 1876, 1790 hours; for 1877, 1794 hours; for 1878, 1591 hours; for 1879, 1535 hours; for 1880, 1567 hours; for 1881, 1405 hours; and for 1882, 1370 hours. From 1872 the annual amount of pain increased and probably reached its maximum in 1874, a year of high pressure which as we proceed will be found to have some relation to the pain.

For 1875 we have the highest recorded amount of pain. Fig. C. The next year 1876, the amount of pain fell off 100

FIG. C.

Annual Pain, Barometer, and Temperature Curves, 1875–1882 *inclusive.*



hours, with a decrease of the mean annual pressure, equal to 00.021 of an inch, with corresponding increase of temperature. For the following year 1877, the pain and pressure remained nearly constant and parallel, with some increase in temperature. For the year 1878, there was a remarkable lessening of 200 hours in the neuralgic amount, but by following up the barometric curve an equally remarkable fall is found. The annual mean of the barometer for the year (1878) was 00.068 of an inch below the mean of the previous year, and 00.067 of an inch below the mean for the eight years: the mean for the eight years being 29.916.[1] From the low annual pressure of this year, we may almost infer a high annual temperature, which we do indeed find in the curve, and the Signal Bureau reported for the Middle Atlantic, the temperature "above the average" for every month in the year except June. For the year the *number* of pain attacks and the *number* of storms remained about normal, but the *duration* of the pain attacks was shortened.

This law of relationship of low pressure and high temperature to amount of pain, and the number of attacks of pain, and number of storms will become more apparent when we come to the consideration of the quarterly and monthly distribution of pain and storm. Since 1878 the pain has diminished at the rate of 40 hours annually; diminution being accelerated by a decrease of mean annual pressure and retarded (or actually held in suspension, as in 1880) by an increasing pressure. Making allowance for the annual decrease of pain, there is a remarkable parallelism between the pain and pressure curve. The yearly temperature bears the same relation to the barometer, as it was found to have in the monthly fluctuations. The total amount of pain for the eight years ending January 1st, 1883, was 12,944 hours, or nearly one-fifth of the time. The distribu-

[1] For these barometric records I am under obligations to Prof. Daniel Draper, Director of the Observatory at Central Park, New York.

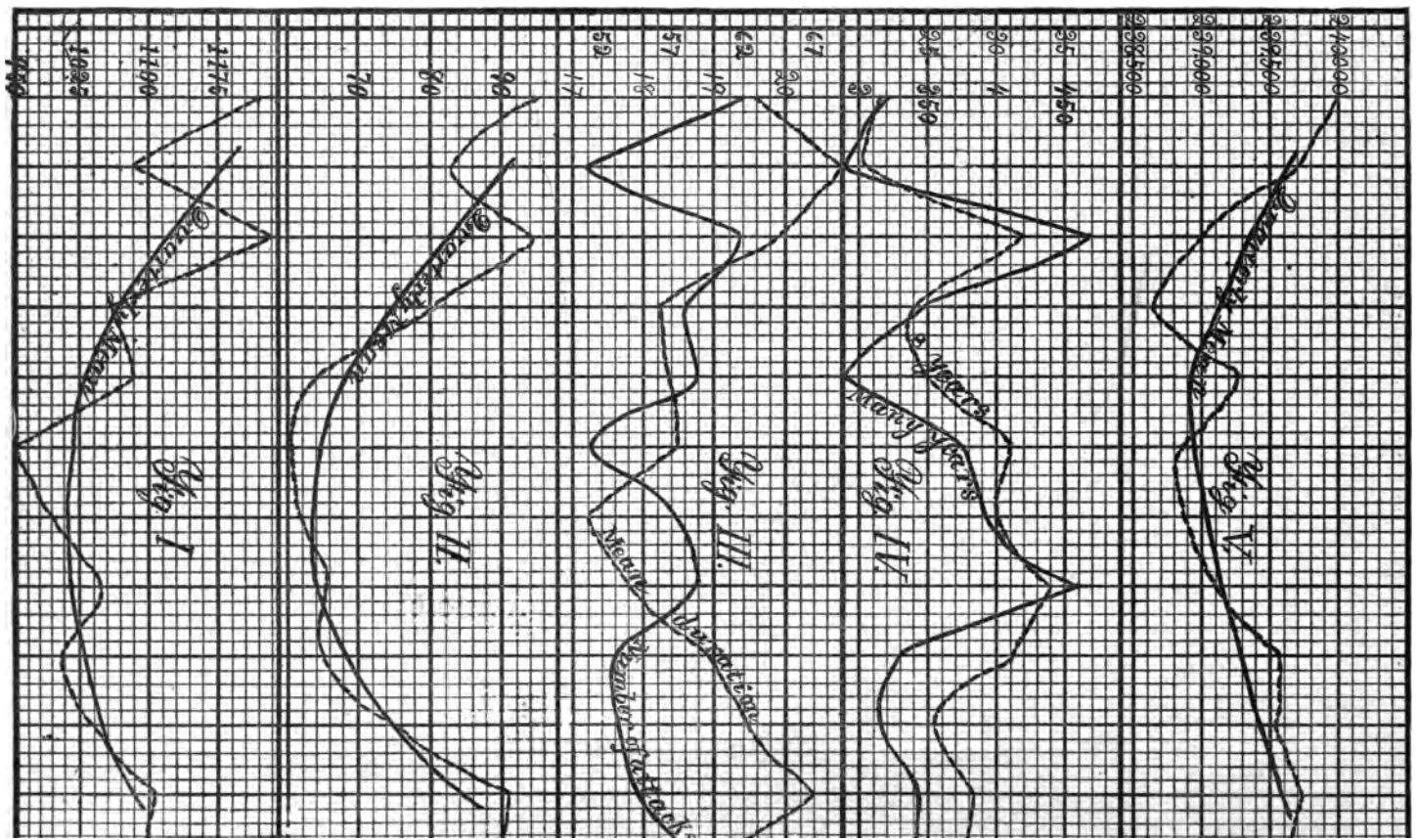

Neuralgic curve on monthly ordinates for 8 years, 1875–1882 inclusive.
Showing number of storms by the months for 8 years, 1875–1882 inclusive.
Mean monthly *duration* and *number* of neuralgic pains, 1875–1882 inclusive.
Monthly rain-fall for many years and for 8 years, 1875–1882 inclusive.
Monthly mean pressure for 8 years (New York), 1875–1882 inclusive.
For 8 years, 1875–1882.
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Fig. I.
Fig. II.
Fig. III.
Fig. IV.
Fig. V.

FIG. D.

tion of the pain is shown by Fig. D.—I., which is the curve of the total monthly amounts for the eight years. It will be readily seen that the winter months hold the advantage as pain-producers, and that for this period while the sun was north of the equator, there were 6783 hours, against 6161 hours while it was south of the equator.

Of the quarterly amounts, the first quarter, beginning with the winter solstice, leads with 3538 hours, followed by the fourth quarter at 3245 hours; then the second, with 3098, and the least in the third quarter (July, August, and September) with 3063 hours.

Of the monthly amounts, March holds the lead, closely pressed by January, and in order of amounts follow: November, December, May, February, April, August, October, September, July, and June. The number of storms, Fig. D. —II., recorded for the eight years is 806, taken from the Signal Bureau Records.

Of this number 529 belong to the winters, against 397 for the summers.

The quarterly numbers, in like manner, correspond to quarterly amounts of neuralgia, and by a reference to the storm curve Fig. D.—II., there is shown a remarkable parallelism throughout with the pain curve.

The average *duration*, Fig. D.—III., of each attack of pain for the whole time, was 18.97 hours; but again we find average *duration* bearing a relation to amount of pain and number of storms; the average for first quarter being 20.1 hours, for second quarter being 18.4 hours, for third quarter 17.9 hours, and for the fourth quarter 19.4 hours, which we see is directly proportional to storm and amount of pain. The average duration of pain was found to be greatest in February, 20.8 hours, one of the coldest, if not the coldest month, and containing probably the greatest barometric fluctuations of any month in the year.

Although the average velocity of translation of the winter storms be greater than the summer ones, owing to their

much greater range and power they are further reaching, and in consequence produce longer attacks. The hottest month of the year (July) gave the least average duration of pain, being seventeen hours.

This is a month of low average pressure and unimportant and minimum barometric fluctuations. By an examination of the curve of the mean monthly *number* of attacks, Fig. D.—III., there is found an almost exact *monthly* parallelism with the pain and storm curve, but the mean *quarterly* of the curve would not be as nearly parallel with the mean quarterly of the pain or storm, which shows that the number of attacks of pain is greater in proportion to the number of storms for summer than for winter. Many of the summer storms are difficult to trace, and some are not charted owing to their indefiniteness, but they are nevertheless pain-producers. For this reason it is believed that the relationship of the number of pain attacks to the number of storms is not as disproprtionate as appears in the quarterly comparison of the curves.

Passing to the rain-curve, Fig. D.—IV., we find it in harmony with the pain and storm curves, except for a few of the summer months. For these months, owing to the short and heavy precipitation of rain, and local character of many of the storms, the curve does not subordinate itself to the pain, storm, or even barometric curve.

Thus we see that rain-fall of itself is only relatively to be used as a measure for pain.

The barometric curve, Fig. D.—V., as it swings almost a catenary from January to December, measures with the storm curve much more accurately the ordinates of the pain curve ; and here we have reappearing in the quarterly and monthly products of neuralgia, the law already disclosed in the annual product of pain, viz.: high temperature, low barometer, favorable for non-product of pain; and in addition, minimum barometric undulations, favoring diminution of pain duration.

The following table gives the full record for years and months of the amount of pain in hours:—

TABLE OF MONTHLY AMOUNT OF PAIN 1875–1882 INCLUSIVE.

202	hours.	Jan. 1875	166	hours.	Jan. 1876	242	hours.	Jan. 1877
166	"	Feb.	175	"	Feb.	105	"	Feb.
189	"	March,	188	"	March,	188	"	March,
130	"	April,	173	"	April,	151	"	April,
182	"	May,	158	"	May,	141	"	May,
120	"	June,	116	"	June,	133	"	June,
122	"	July,	111	"	July,	123	"	July,
175	"	August,	132	"	August,	144	"	August,
105	"	Sept.	155	"	Sept.	166	"	Sept.
135	"	Oct.	105	"	Oct.	125	"	Oct.
190	"	Nov.	160	"	Nov.	140	"	Nov.
176	"	Dec.	151	"	Dec.	136	"	Dec.
—	1892		—	1790		—	1794	

118	hours.	Jan. 1878	145	hours.	Jan. 1879	127	hours.	Jan. 1880
126	"	Feb.	131	"	Feb.	132	"	Feb.
152	"	March,	140	"	March,	141	"	March,
127	"	April,	121	"	April,	122	"	April,
133	"	May,	116	"	May,	103	"	May,
90	"	June,	150	"	June,	117	"	June,
131	"	July,	132	"	July,	149	"	July,
135	"	August,	133	"	August,	121	"	August,
114	"	Sept.	122	"	Sept.	115	"	Sept.
160	"	Oct.	121	"	Oct.	174	"	Oct.
145	"	Nov.	115	"	Nov.	131	"	Nov.
160	"	Dec.	159	"	Dec.	135	"	Dec.
—	1591		—	1535		—	1567	

127	hours.	Jan. 1881	93	hours.	Jan. 1882
121	"	Feb.	128	"	Feb.
127	"	March,	109	"	March.
120	"	April,	118	"	April,
144	"	May,	112	"	May,
107	"	June,	114	"	June,
98	"	July,	131	"	July,
118	"	August,	102	"	August,
105	"	Sept.	124	"	Sept.
89	"	Oct.	129	"	Oct.
123	"	Nov.	100	"	Nov.
126	"	Dec.	110	"	Dec.
—	1465		—	1370	

To determine the average distance of the storm-centre at the beginning of the pain attacks sixty well-defined storms through ten consecutive months were taken, and it was thus found that the average distance was 680 miles, ranging from 200 to 1200 miles.

Storms from the Pacific are felt the farthest off, very soon after crossing the Rocky Mountains. Those which move along the coast from the Gulf of Mexico, are associated with neuralgia not quite so intense, and are not felt, as a rule, until within the average neuralgia distance.

If neuralgia begins on a low and rising barometer, the ridge of high pressure between this and the coming storm-depression is narrow and invariably broken down within seventy-two hours, and more frequently within twenty-four or thirty-six hours; and during this rise, coincident with the pain, the difference between the wet and dry bulb thermometers, instead of increasing as is usual with this barometrical condition, sometimes actually diminishes, or increases for a few hours only, and then diminishes, showing increasing humidity.

When this pain and instrumental condition obtains, the coming storm depression will carry on its eastward side clouds and increasing moisture, and sometimes rain or snow, clear over the summit of the advancing high area pressure in front of it, holding an unusually high degree of relative humidity in the air on the high eastern slope of the high barometer area. These are the conditions when the pain attacks on the rising barometer. Its normal condition, however, is with a falling but it may be a high barometer, rising temperature, and increasing relative humidity.[1]

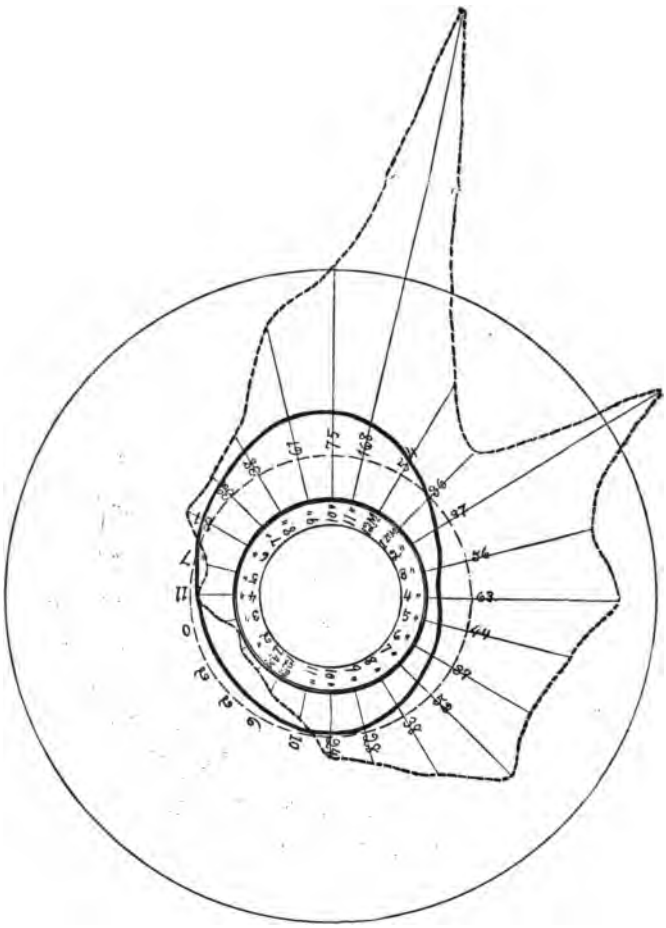
Should the pain be on during a day of intermitting rain, the pain takes an additional activity just before the increasing shower, and continues 20 to 40 minutes; this will sometimes happen four or five times in twelve hours. Each little increment of pain seems to bear about the same relation to the showers, as the main attack bears to the storm.

For the hourly relations of pain see curve Fig. E., which shows the number of times the pain began on each hour of the day. The time of record extends over a period of more than eleven years, commencing September, 1871, and is continuous since October, 1874.

It has always been observed that eating a meal, when the pain is on, intensifies it, and it is believed that it often hastens the attack. We should then expect to find some rise

[1] See same case in American Journal of Medical Sciences for April, 1877, p. 21.

FIG. E.



in the curve after each meal. This we do find at 9 A. M., which cannot be accounted for otherwise than that by eating at 8 A. M., some of the neuralgia, which really belongs to 10 o'clock, has been prematurely developed and so changed to 9 o'clock. Again after the 1 o'clock meal, there is a decided rise in the number, *some* of which, at least, should be chargeable to the meal. It is also worthy of note that there

is an ebb-tide in pain, just preceding the meals: not so marked before breakfast, partly, no doubt, because it is with me a little less regular than other meals, and partly because storms coming within neuralgia range during the early and middle sleeping hours, would not ordinarily arouse their victim, but would strike in the morning as the sleep became less profound.

This, doubtless, is the cause of the rapid rise in the curve, between 5 and 6 A. M.

In support of this statement of the respect which a storm may have for its neuralgia subject, it may be added, that if the pain is on when the patient falls asleep, and he is aroused or awakens during the night, he will find himself free from pain; but if he should move about, or stay awake 15 or 20 minutes, the pain is renewed, unless, in the mean time, the neuralgia time has expired.[1] At 11 P. M. the average number of attacks is not one a year, and from this time until 6 A. M., there is great immunity from *onsets* of pain.

With regard to the prominent and remarkable feature of the curve on the 11 A.M. ordinate, it cannot be positively stated why the pain has shown this great partiality; but there are some reasons which may be of interest to state. We have found that the years of high mean annual pressure gave high pain readings. We have also found that neuralgia in its relation to storms was not averse to a high barometer, but usually attacked on a falling barometer with rising temperature or increasing humidity.

The diurnal oscillation of the barometer is indicated by the elliptical curve in Fig. E., which has for its ordinates the distances from the curve to the dial circle, and for its abscissas the hours of the day. The difference between the

[1 This is true in regard to most pain, and may be within the experience of many men; we fall asleep, suffering, but awake without pain, even if the cause of pain remains. A brief period of being awake seems to be needed, in order that the cause become active. Sleep is a true anæsthetic.—S. W. M.]

maximum and minimum pressure is 00.045 of an inch. The minimum occurs about 4 P. M., and the maximum between 9 and 10 A. M., and begins its decided fall between 10 and 11. This brings the pain then in its relation to the diurnal change of the barometer to a position analogous to what we found it in its relationship to barometric movements accompanying storms—that is, high barometer, and on its fall preceding the storm, with increasing humidity and temperature. For the eight hours from 9 A. M. till 4 P. M., during the daily fall of pressure, there are 610 onsets against 346 for the remainder of the day, or 16 hours. The maximum amount of vapor is in the air from 2 until 6 P. M., increasing from before sunrise till just before sunset. We have then for the greatest daily neuralgic period a corresponding falling barometer, increasing vapor and temperature, with the analogous condition complete.

In regard to the 11 A. M. period, there are some other points of interest.

By a reference to the diurnal changes in the magnetic curves (Figs. A. and B.), we find: in the declination curve two maxima and two minima daily. The principal maximum occurs at 8 A. M., and the principal minimum at 2 P. M. From this minimum in its progressive movement there is a slight undulation in the curve about 10 P. M., giving rise to a subordinate maximum with another minimum following two hours later near the mean of the curve; from this we reach the principal maximum at 8 A. M.

In the inclination curve we have also two maxima and two minima. The leading and principal feature of this curve is its morning maximum which occurs between 10 and 12 M., probably 10.45 or 11 A. M. A subordinate maximum about 10 or 11 P. M. There is a minimum between 5 and 6 A. M., and another about 5 P. M.

Each of these maxima has a corresponding minimum in the horizontal force. So also the minima in inclination correspond in like manner to maxima in horizontal force. Owing to the great and precipitate change in declination

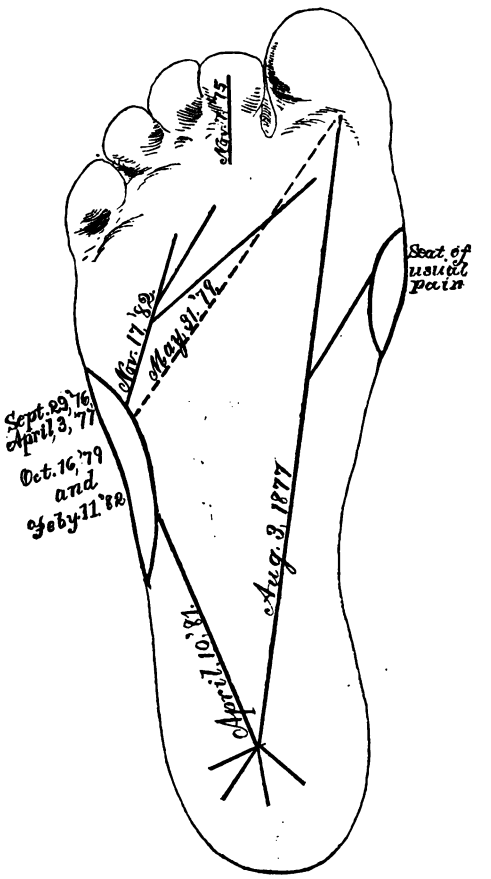
between 8 A. M. and 2 P. M. with the pronounced occurrences in inclination and horizontal force at or close to 11 A. M., may we not with some reason suspect these as active agencies in constructing the 11 A. M. neuralgic period?

The 2 o'clock period is one connected with the highest temperature and the maximum wind force of the day. It is believed that hours of maximum and minimum rain fall have some influence on this curve. The British Government[1] has published some observations which, although not conclusive, seem to show that there are two daily maximum rain falls, one at 7 P. M., and one at 5 A. M.; also two minimum periods, near noon and midnight. It is believed, further, from sensible impressions and limited observations, that solar and earth's radiation have an influence on the daily character of the neuralgia, and if fully studied would assist in interpreting some features of the curve not fully understood. With complete record of *local* meteorology, including radiation, there seems but little doubt that all the details of the diurnal curve could be demonstrated. There is one additional fact in connection with the onsets of pain which seems curious, and that is the period of drowsiness and sleepiness which precedes the attacks from one to five hours. This rule is not invariable, but is general.

For the seven years from Nov. 7, 1875, to Nov. 17, 1882, there have been nine neuralgic attacks of great and unusual power. These were characterized by pain in nerves not usually attacked. The ordinary neuralgia is confined to the position indicated in Fig. F., and is of the burning and boring kind, with twitchings of nerves in the stump, while in the extraordinary attacks, in addition to the pains as above named, we have the intense stabbing variety, with a much higher degree of the convulsive tendency. Accompanying each of these attacks except the last, we have the pain period dominated by more than one storm in six out of the nine attacks, and in *every* case the low barometric depression was of

[1] Prof. Loomis in Am. Jour. Sci. and Art, July, 1875.

FIG. F.



unusual and enormous extent. The attack of Nov. 7, 1875, began at 7 P. M. and lasted until 2 P. M. on the 8th, and was undoubtedly mainly under the influence of storm No. IX. (as charted by Signal Bureau), while passing from Savannah to a position off Cape May. The depression of this storm "became more extended as it advanced, with increasing velocity; the region of precipitation including the entire Southern and Middle States." By 7 P. M., closely following this attack, was an attack of the regular neuralgia, which

lasted 27 hours, to meet the requirements of Storm VI.; and this is a general rule, that these unusual attacks are followed by the regular neuralgia.

The attack of September 29 and 30, 1876, was under the influence of storms IX. and X. of that month. The weather report of the Signal Bureau says: "The map of the 29th, 4.35 P. M., shows that at that time a very large area of low pressure must have existed in British America on the south and east of James Bay, the southern end of which extended southward until on the morning of the 30th, the barometer was below 30 inches everywhere east of Lake Superior. The winds of Georgia and Indiana during this time were from east to southeast.

The attack of April 3, 1877, belongs to Signal Bureau Storms, Nos. II. and III. "An extensive area of cool northeasterly winds prevailed throughout the gulf States, Ohio Valley, and Lower Lakes." In Middle Atlantic States northerly winds moving to east with increasing cirrus and cirro-stratus cloudiness. The general depression extended over a large area. The attack of August 3, 1877, belongs to storm marked II. on monthly report. "There was a marked fall of the barometer in the Southern Atlantic States on the 2d, which district was then, in all probability, in the N.W. quadrant of an extensive depression." "N. E. winds prevailed from New York to Florida." The neuralgia attacked at 11 A. M., and at this time in the direction of the storm S. E. there were increasing cirrus and cirro-stratus with bunches of cumuli lower. This storm "united with No. I. over the St. Lawrence. Later in the day thunderstorms in northwest to northeast." The attack of May 31, 1879, corresponds to the extensive storm of No. XV. of Signal Bureau Report for the month.

The attack of October 16th corresponds to Storms IV. and V.; the former coming up the Mississippi Valley unites with the latter from the North Pacific, in Lake Michigan.

The attack of April 10, 1881, is related to Storm III.,

including Storms II. and IV. as described by the Signal Bureau Report.

It was observed on this occasion, as is frequently the case with this variety of pain, as also in the ordinary kind, that there was a cloudless sky with a delicate milky sheen in the atmosphere, more marked around the horizon. This milky veil becomes more opaque, and the first pronounced cloudiness will be small patches of cumulus, at lower elevation than this hazy appearance. These are storm indications, and favorable for the production of pain. This was the stabbing variety, as in each case here described, added to the other varieties, and was active between the heel and left side of foot. (See Diagram.)

The attack of February 11, 1882, corresponds to Storm VI. as marked in report of Signal Bureau. At the time the attack began, the centre of the storm was 600 miles westward. This was of wide lateral range, and is the only one charted for the month as coming from the Pacific coast.

For attack of November 17, 1882, Prof. Carpmail, Superintendent of the Toronto Observatory, reports more than ordinary declination and force disturbances from the 10th, including the 16th, when "they evidently showed signs of a coming storm." The magnetic storm set in at 5 A. M. on the 17th, and continued with great and intermitting force all day and night, and did not quiet down till midnight of the 18th. The report says, referring to the evening of the 17th, "that the force (horizontal and vertical) instruments, which in the early part of the storm showed a general decrease, now showed an increase, and between 7 P. M. and midnight, the lights several times travelled to both ends of the paper; the bifilar going off a number of times." The extremes of declination were reached easterly at 6.25 P. M., and westerly at 9 P. M. On the 19th, the magnets were disturbed. The disturbances being greatest between 11 P. M. of the 19th and 4 A. M. of the 20th. Many of the force movements were swift and rapid. The last movement of

importance occurring at 9.20 P. M. on the 20th. Brilliant auroras reported on the 17th.

This storm was unusually severe in England with brilliant aurora on the 17th. The disturbances here probably did not differ materially from those reported from the Toronto Observatory.

There was from the 10th instant, great unrest in all the nerves of the foot, such as feelings of twitching and slight burning, and at no time did the agitation touch the zero line of no pain. At 2 P. M. of the 17th the intense stabbing pains set in and reached the maximum power from 4 to 7 P. M. They continued, however, with great force until 5 A. M. on the 18th, and intermitting and less strong fits of torment were felt till evening; then a period of rest occurred until 9 A. M. of the 19th, when a severe attack of the regular neuralgia set in, with more or less burning and twitching pains throughout the foot, which lasted more than thirty-one hours, and finally went off on the evening of the 20th. The intense neuralgia of the 17th seems connected with the magnetic storm of the 17th, for there was no storm of barometric depression charted by the Signal Bureau within neuralgic range for this date. The last storm preceding this time was storm No. II., which started from the Pacific on the 8th, and for which there was a regular neuralgia on the 9th and 10th. The next storm was No. III., which originated in Texas on the 18th, and the attack of pain of the 19th and 20th was for this storm aggravated by the magnetic condition of these dates. It is firmly believed that neuralgia accompanies intense auroral periods, but owing to their rare occurrence, it cannot be said that the proof is conclusive. The conjunction of the two seems too frequent for mere coincidence.

In regard to treatment, etc., I can say but little. There has been no treatment in a medical way of late. I have had good health, take a great deal of exercise, but in a rather irregular way; my appetite is always good, and I sleep well, except when the disturbance of neuralgia interferes. For the

year 1878, in which occurred the greatest diminution of pain for any year, there was the greatest physical weight, reaching 190 pounds. Physical exercise, nutritious food (have found milk most fattening of all), and light, agreeable occupation, are, I found, the best regimen for this neuralgic subject.